Livestock Research for Rural Development 18 (2) 2006 | Guidelines to authors | LRRD News | Citation of this paper

Growth performance and parasite infestation of goats given cassava leaf silage, or sun-dried cassava leaves, as supplement to grazing in lowland and upland regions of Cambodia

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Abstract

The experiment was an on-farm trial, conducted from 1st August to 31st October, 2004 (wet season) in two communities, one in the lowland region along the Mekong river bank and the other in an upland region in Pursat province. A factorial design (3*2) was used to compare supplements of cassava foliage in ensiled form (EC), cassava foliage in dried form (DC) and natural grass (NC). 12 farmers in each community were allocated to 4 groups (replicates), and within each replicate to one of the three supplements.. Each farmer in the lowland region received 2 local entire male goats; in the upland region each farmer received 2 female goats. The traditional management system was followed with free grazing from 8.00 am until 4.00 pm, and night-time confinement in a shed with raised floors where they were offered the forage supplements ad-libitum.

Growth rate was higher in the upland (55.3g/day) than in the lowland region (34.7g/day). Supplementation with EC (63g/day) was more effective than DC (34g/day) and NC (37g/day). DM intake with supplement of EC (349g/day) was higher than DC (201g/day) and NC (126). There was a positive relationship between growth rate and supplement intake (R^2= 0.53). Faecal egg counts (FEC) were higher in goats in the lowland than in the upland region. In the lowland region there was an indication of lower FEC in goats supplemented with EC compared with DC or NG.

It is concluded that conserved cassava foliage, especially in ensiled form, can play an important role in supporting good growth performance as well as providing some protection against nematode infestation of goats at small household farming level.

Key words: Cassava foliage, goats, growth rate, natural grass, nematode, region

Introduction

Goats are found in all types of environments, from arid to humid zones. They do very well in the drier tropics, where their ability to withstand dehydration and their browsing habit enable them to survive where cattle or sheep cannot. They are often found in areas with fragile ecosystems, where often they are blamed for degrading the natural resource base (Steel 1996). A number of different systems of goat production exist, including subsistence, extensive and intensive.

In Cambodia, goat production is still limited when compared with other forms of livestock production. Some farmers in upland areas are familiar with goat raising as a traditional source of meat for celebrations or family consumption. Usually, goat production is practiced in the traditional management system, in which the goats are released for day-time grazing and are housed in a pen with raised floors at night-time.

A major constraint to goat production in the extensive system is the occurrence of natural disasters, especially drought and flooding. Another limiting factor in grazing goats is the high rate of internal parasite infestation (Waller 1999; Kochapakdee et al 2001).

Most species of browse plants are more drought-tolerant than grasses, thus they may be considered as a more reliable feed resource of high quality on which to develop sustainable feeding systems (Woodward and Reed 1989). Due to the fact that these plant resources are locally available, perennial sources of feeds (Singh 1995; Leng 1997), and are rich in protein, they are particularly appropriate for small ruminants (Seng Sokerya and Rodriguez 2001).

In Cambodia, t he pressure to increase crop production and deforestation for extraction of timber have resulted in feed shortages for grazing animals, especially in the dry season. It has been observed that during these "lean" periods, the farmers often supplement their goats with foliage from trees and shrubs (Nguyen Thi Mui et al 2000; Seng Sokerya and Preston 2003; Theng Kouch et al 2003). Cassava (*Manihot esculenta*) is one of these shrubs, which has been recognized as locally available feed resource for both non ruminant and ruminant production (Preston 2001; Wanapat 2001).

Objectives

The objective of this research was to measure the impact of introducing conserved cassava leaves as supplementary feed for grazing goats in two different locations (lowland and upland areas).

Material and Methods

Location and duration

The experiment was conducted in two communities where Heifer International-Cambodia has been working. One community was located in the lowland area (Ogna Ong village) along the Mekong river bank, in Kandal province; the other community was located in the upland region in Pursat province (Chamraen Phol village), in the Southwest part of Cambodia. The research took place during the wet season, over a 3 month period, starting on August 1, 2004 and finishing at the end of October 2004.

Farmer selection

Twenty-four farmers (including 8 women householders) were selected, using a participatory process. In each community, 12 farmers were assigned to one of three supplementation treatments, such that there were four replicates of each treatment. This process was facilitated through the collaboration between Heifer Cambodia staff and the provincial Animal Health Office project partner who currently work in these communities. The participants were recognized as small-scale household families with limited resources, but strong commitment.

Treatment and experimental design

The three treatments were arranged in a 3*2 factorial design with 4 replications as follows:

Supplement

- Ensiled cassava foliage (EC)
- font face="Times New Roman">Dried cassava foliage (DC)
- Natural grass (NC)

Region

- Lowland (L)
- Upland (U)

Animals and feeds

Twenty-four non-castrated male goats at about 4 months of age, and averaging 14.2±2.8 kg live weight, were purchased from local farmers to provide to the 12 participants in the lowland area. Another 24 female goats (similar age and live weight) were purchased for allocation to the 12 farmers in the upland area. Each farmer in each location received 2 goats. All goats were vaccinated with FMD and injected with Ivomec (1ml/25kg live weight). A simple shed, with raised wooden floors, was built by all participants (Photo 1), and planted cassava in a small plot of 100m^2 (Photo 2).

Photo 1. The wooden shed used for the goats at night-time

Photo 2. Drying the cassava leaves from plots planted
by the families participating in treatment DC

Cassava leaves were purchased from local farmers in quantities to provide the needs of treatments DC and EC for the first one or two months, according to the possibilities for local production of cassava by the farmer. One half of the cassava leaves was ensiled with palm syrup (5% w/w fresh basis); the other half was sun-dried. The conserved leaves were then distributed to the farmers.

The participants managed the animals in the traditional system of free grazing during the day, usually herded by the children but occasionally by the parents when the children were in school. At night-time, the goats were given free access to the conserved cassava leaves as treatments (DC and EC) or to natural grass (NC) harvested locally.

All the participants made a one-day visit (July 2004) to CelAgrid (UTA-Cambodia) to learn the basic features of goat management as well as the growing and conserving of the cassava foliage. During that time, they also had the opportunity to improve their understanding about integrated farming systems.

Sampling procedure, data collection and analysis

The live weight of the goats was measured every two weeks, in the morning before grazing. The amount of supplement consumed was recorded every day and samples of each retained for analysis at CelAgrid. Dry matter was determined by micro-wave radiation (Undersander et al 1993). Nitrogen and ash were determined by methods of AOAC (1990). Water extractable DM and N were determined by the procedures described by Ly and Preston (1997). Samples of faeces were taken every month directly from the rectum of the goats, for determination of faecal egg counts (FEC), according to the method of Hansen and Perry (1994).

Statistical analyses

The data were subjected to analysis of variance (ANOVA) using the General Linear Model option (GLM) of the MINITAB software version 13.2. Sources of variation were supplement, region and error. In cases when the "F" coefficient was significant at P<0.05, the means were separated by the Tukey test in Minitab software. Growth rates were calculated by regression of live weight (g) on time (days). The data for faecal egg counts were transformed by the power of $\log_{10}$ prior to analysis.

Results

Chemical composition of diet

The crude protein was higher in the ensiled cassava leaves than in those that were sun-dried (Table 1). The natural grass was higher in crude protein than the dried cassava leaves.

Table 1. Chemical composition of the supplements such as ensiled cassava (EC), dried cassava (DC) foliages and natural gra

Chemical composition	% DM	%CP in DM	HCN, mg/kg DM	% Water-extractab
				DM
Ensiled cassava foliage	32.4	24.5	215	43.9
Dried cassava foliage	87.8	18.4	120	30.5
Natural grass (lowland)	16.8	22.6		24.6
Natural grass at (upland)	21.3	21.7		33.3

Growth rate and feed intake

Growth rates were higher for goats in the upland area than in the lowland area, and for those supplemented with ensiled cassava leaves compared with those receiving sun-dried leaves or natural grass (Table 2).

Table 2. Mean values for growth rate and supplement intake of goats in upland or lowland area, given sun-dried (DC) or ensiled (EC) cassava leaves or natural grass (NG)

	Lowland	Upland	SEM/P	DC	EC	NG	SEM/P
Live weight, kg							
Initial	14.4	14	0.4/0.514	14	14.6	14.1	0.4/0.619
Final	17.4	19	0.6/0.067	17.1	20	17.4	0.7/0.015
Daily gain, g	34.7	55.2	5.2/0.008	34.4a	63.1b	37.4a	6.4/0.005
Intake of supplementary forages, g/day							
DM	125	258	25.4/0.002	201b	249b	126a	31.1/0.038
Crude protein	27.4	56.1	5.6/0.002	36.8a	60.9b	27.5a	6.8/0.008

ab Means without common letter are different at P<0.05

Growth responses were related to intakes of the supplement (Figure 1) and especially the intake of protein (Figure 2). The intakes of DM were higher for goats supplemented with cassava leaves (both dried and ensiled) compared with those supplemented with natural grass. However, the protein intake was higher for ensiled than for sun-dried leaves, which were similar to the natural grass.

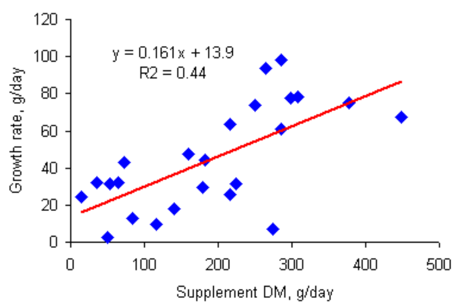

Figure 1. Relationship between DM intake of supplement and growth rate

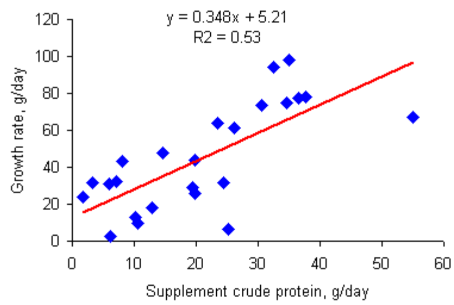

Figure 2. Relationship between crude protein intake of supplement and growth rate

There was no interaction between location and type of supplement (P=0.52), although there appeared to be a greater growth response to the ensiled cassava leaves in the upland area (Figure 3).

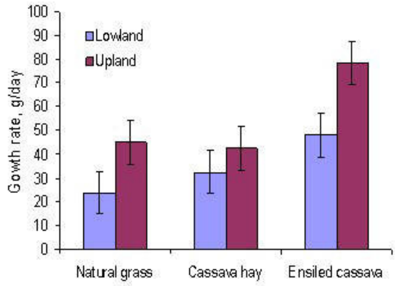

Figure 3. Mean values for growth rate of goats in upland or lowland area, given sun-dried or ensiled cassava leaves or natural grass

Intakes of DM and of crude protein in each location and for each type of supplement are shown in Figures 4 and 5.

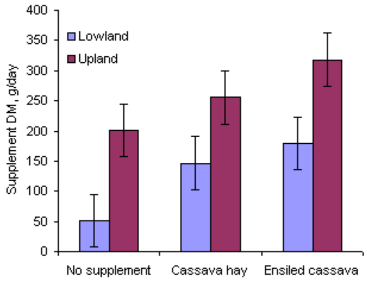

Figure 4. Mean values for supplement DM intake of goats in upland or lowland area, given sun-dried or ensiled cassava leaves or natural grass

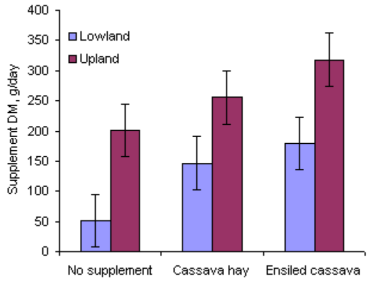

Figure 5. Mean values for supplement crude protein intake of goats in upland or lowland area, given sun-dried or ensiled cassava leaves or natural grass

Faecal egg count

There were differences in FEC between locations (Table 3).

Table 3. Mean values for monthly FEC of goats in upland or lowland area, given sun-dried (DC) or ensiled (EC) cassava leav

	7/8/2004	5/9/2004
Location		
Lowland	31.3	63.8
Upland	684	604
Prob.	NS	0.001
Supplement		
DC	459	398
EC	351	223
NC	263	381
Prob.	NS	0.02
Interaction:		
Location*supplement	NS	0.002

#Values for SEM are not given as these apply only to the transformed data
abc Means without common letter are different at P<0.05

At the beginning of the experiment FEC was higher in the goats in the upland area, although the degree of infestation was low (FEC <700). However, after the second month the pattern of the development of the FEC was quite different (Figures 6 and 7). The FEC declined slightly in the goats in the upland region but had increased markedly in the goats in the lowland area by the end of the trial.

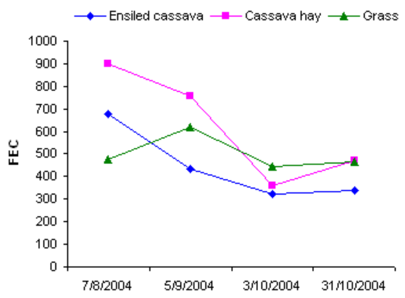

Figure 6. Trends in the FEC of goats in the upland region
according to supplementation EC, DC and NG

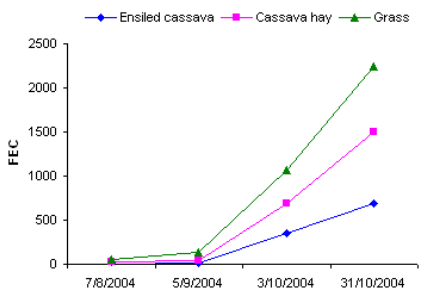

Figure 7. Trends in the FEC of goats in the lowland region
according to supplementation EC, DC and NG

There were significant interactions between effect of location and of supplement on the FEC (Table 3). There were no differences in FEC of the goats in the upland region due to supplementation (Table 4 and Figure 6).

Table 4. Mean values for monthly FEC of goats in upland or lowland area, given sun-dried (DC) or ensiled (EC) cassava lea

	7/8/2004	5/9/2004
Lowland		
Ensiled cassava	24.4	11.3a
Cassava hay	20.6	39.4a
Grass	48.8	141b
Prob.#	0.192	0.001
Upland		
Ensiled cassava	677	435
Cassava hay	897	756
Grass	478	621
Prob.#	0.149	0.863

#Values for SEM are not given as these apply only to the transformed data
abc Means without common letter are different at P<0.05

By contrast, in the lowland area, supplementation with ensiled cassava leaves reduced the FEC compared with the supplements of dried cassava leaves or natural grasses, the effect being especially evident by the end of the experiment (Figure 7). Although the FEC tended to be lower with the dried cassava leaf supplement the differences were only significant at the second month when in general the FEC values were low. At the end of the experiment, there appeared to be a clear advantage in control of nematode infestation in favour of the ensiled compared with the sun-dried leaves.

Discussion

Growth performance

The experiment was conducted in the rainy season and this resulted in major differences in availability and nature of the grazing. Major areas in the lowland area were flooded and this restricted the opportunities for grazing. Also it was to be expected that the potential risk of parasite infestation would be greater in the lowland area as the wet condition would have favored the development of the nematode larvae on the grasses. By contrast, the upland area was drier and there was a greater and more diverse range of available feed resources. The combination of the above factors could be expected to result in a more favorable nutritional and climatic environment for the goats in the upland area. A similar situation was reported by Theng Kouch et al (2004), in that growth performance and parasite burdens of goats in lowland areas were much worse in the wet compared with the dry season.

There appear to be no reports on the use of ensiled cassava leaves as a supplement for grazing goats. Improvements in growth rate and reduction in FEC were reported by Seng Sokerya and Rodríguez (2001) when fresh cassava foliage was compared with natural grass as a supplement to brewer's grains fed to goats in confinement. A similar positive effect was attributed to cassava foliage compared with natural grass fed as supplements to a basal diet of wheat bran (Seng Sokerya and Preston 2003).

The different response to ensiled versus sun-dried cassava leaves appears to be due to the superior palatability of the ensiled form which resulted in a higher intake of crude protein. It has been shown that protein intake is a major determinant of ruminant performance due to increased availability of fermentable nitrogen and other nutrients required by rumen bacteria, as well as the greater opportunities for some of the protein to escape the rumen fermentation (Preston and Leng 1987). The protein in sun-dried cassava foliage has been reported to be comparable with that in cottonseed meal as a source of escape (or bypass) protein (Promkot and Wanapat 2003). The protein in ensiled cassava leaves could be expected to have poorer rumen "bypass" characteristics due to partial degradation of the protein during the ensiling process (McDonald et al 1995). The higher value for "water-extractable" N in ensiled (67%) compared with sun-dried cassava leaves (56%) (Table 1) is indicative of such a difference.

Effect of supplements on FEC

The effect of the ensiled cassava leaves in reducing the FEC of goats in the lowland areas can probably be ascribed to the presence of condensed tannins as has been reported by Wanapat et al (1997) and Netpana et al (2001). The superior effect of the ensiled over the sun-dried form was probably because of the higher intake of DM and therefore of condensed tannins and of protein in the ensiled compared with the dry leaves. Beneficial effects of condensed tannins in reducing nematode infestations in small ruminants have been reported by several workers (Granum et al 2003; Molan et al 2002; Butter et al 2000; Kabasa et al 2000; Kahn and **Diaz-Hernandez** 2000; Niezen et al 1996). An improved protein status of the animal has also been shown to reduce nematode infestation (Nolan 1999).

Conclusions

- Supplementation of grazing goats with ensiled cassava leaves increased the live weight gain by 69% compared with a supplement of native grass and by 68% compared with sun-dried cassava leaves.
- The lack of response to sun-dried cassava leaves appeared to be due to the lower palatability, which resulted in a 40% lower intake of crude protein from the supplement.
- Growth rates were 59% higher for goats in the upland compared with the lowland region.
- The FEC of the goats in the lowland areas was reduced from 2250 on the native grass supplement to 700 on the ensiled cassava leaf supplement. The sun-dried leaves were much less effective.

Acknowledgments

The authors wishes to express their gratitude to the MEKARN project, supported by SIDA/SAREC of Sweden for financing this study. Grateful thanks also to Mr. Kong Ratrei, VAHWs and all farmers who fully participated to accomplish the study.

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Received15 December 2005; Accepted 24 December 2005; Published 10 February 2006

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